

CLAIMS

1. An atmospheric pressure plasma assembly (1) comprising a first and second pair of vertically arrayed, parallel spaced-apart planar electrodes (36) with at least one dielectric plate (31) between said first pair, adjacent one electrode and at least one dielectric plate (31) between said second pair adjacent one electrode, the spacing between the dielectric plate and the other dielectric plate or electrode of each of the first and second pairs of electrodes forming a first and second plasma regions (25,60) characterised in that the assembly further comprises a means of transporting a substrate (70,71,72) successively through said first and second plasma regions (25,60) and an atomiser (74) adapted to introduce an atomised liquid or solid coating making material into one of said first or second plasma regions.
2. An assembly in accordance with claim 1 wherein the substrate is transported through said first and second plasma regions by means of guide rollers and/or guide reels (70, 71, 72).
3. An assembly in accordance with any preceding claim wherein each electrode comprises an electrode unit containing an electrode (36), an adjacent dielectric plate (31) and a cooling liquid distribution system (20,26) for directing a cooling conductive liquid onto the exterior of the electrode (36) to cover a planar face of the electrode (36).
4. An assembly in accordance with claim 3 wherein the cooling conductive liquid is water.
5. An assembly in accordance with claim 3 or 4 wherein the electrode unit is in the form of a watertight box (20, 20a, 26) having a side formed by a dielectric plate (31) having bonded thereto, on the interior of the box (20,20a, 26), a planar electrode (36) together with a liquid inlet (14) and a liquid outlet (15).

6. An assembly in accordance with any preceding claim retained in an outer casing in which a lid (76) is provided to prevent escape of a process gas which is required in order to activate the plasma.
7. An assembly in accordance with any preceding claim wherein the atomizer (74) is an ultrasonic nozzle.
8. An assembly in accordance with any preceding claim wherein the electrode (36) is a dielectric with a metallic coating.
9. An atmospheric pressure glow discharge assembly in accordance with any preceding claim.
10. An atmospheric plasma assembly for preparing multilayer coatings upon flexible substrates in accordance with any one of claims 1 to 9 wherein plasma is generated between vertically orientated electrodes (36), which are arranged in series and adapted to enable single pass, multiple treatment or multilayer coatings.
11. A method of atmospheric plasma treating a substrate comprising using the apparatus described in any preceding claim, wherein the atomised solid or liquid coating making material is transferred from the atomiser (74) into the plasma region (60) by means of gravitational feed.
12. A method in accordance with claim 11 wherein the atomised solid or liquid coating material is introduced into the plasma region in the absence of a carrier gas.
13. A method in accordance with claim 11 or 12 wherein the substrate is synthetic and/or, natural fibres, woven or non-woven fibres, powder, siloxane, fabrics, woven or non-woven fibres, natural fibres, synthetic fibres cellulosic material

and powder or a blend of an organic polymeric material and an organosilicon-containing additive.

14. A method of atmospheric plasma treating a substrate comprising, transporting a substrate through an atmospheric pressure plasma assembly in accordance with any one of claims 1 to 10 upwardly through one plasma region (25,60) and downwardly through the other plasma region (25,60).
15. A method in accordance with any one of claims 11 to 14 wherein the first plasma region (25) through which the substrate passes is a cleaning plasma and the second plasma region (60) through which the substrate passes effects a coating on the substrate by means of the atomised liquid or solid coating forming material.
16. A method in accordance with claim 15 wherein the gravitational feed of the atomised liquid or solid coating forming material into the second plasma region (60) prevents transfer of said atomised liquid or solid coating forming material into the first plasma region (25).
17. A method in accordance with any one of claims 11 to 16 wherein, in use, the temperature of the assembly is maintained in the range of from room temperature to 70° C.
18. A treated substrate obtainable in accordance with the method as described in any one of claims 10 to 17.
19. Use of a coating for a substrate prepared by the method of any one of claims 1 to 17 to enhance the barrier and/or diffusion properties of the substrate, and/or enhance the ability of additional materials to adhere to the substrate surface.
20. Use of a coating for a substrate prepared by the method of any one of claims 1 to 17 to increase hydrophobicity, oleophobicity, fuel and soil resistance,

enhance gas and liquid filtration properties and/or the release properties of the substrate.

21. Use of a coating for a substrate prepared by the method of any one of claims 1 to 17 to enhance water resistance and release properties of the substrate, and/or enhance the softness of fabrics to touch.
22. Use of a coating for a substrate prepared by the method of any one of claims 1 to 17 as a water wettable coating, bio-compatible coating or an adhesive layer to promote adhesion to substrate surface or as part of laminated structure.
23. Use of a coating for a substrate prepared by the method of any one of claims 1 to 17 to provide surface conductivity to the substrate and/or enhance its optical properties.
24. Use of a coating for a substrate prepared by the method of any one of claims 1 to 17 to provide surfaces with controlled pH, and/or controlled interaction with biologically important molecules such as amino acids and proteins.